Fully Funded PhD Scholarship in Palaeoceanography
Geography, iCRAG SFI Research Centre

Application(s) are invited from suitably qualified candidates for full-time funded PhD scholarship(s) starting in March, 2023 affiliated to the College of Arts/School of Geography, Archaeology and Irish Studies/Geography/iCRAG at the University of Galway.

University of Galway:
Located in the vibrant cultural city of Galway in the west of Ireland, with over 18,000 students and more than 2,400 staff, the University of Galway has a distinguished reputation for teaching and research excellence https://www.universityofgalway.ie/our-research/

The successful candidate(s) will undertake training and research on

PhD 1: The impact of physiological and ontogenetic processes on geochemical tracers recorded in planktonic foraminifera.

PhD 2: The impact of early diagenetic processes in surface marine sediments on geochemical tracers recorded in planktonic foraminifera

Brief Project Description
Project SiTrAc pioneers a novel cross disciplinary approach to develop and apply indirect measures of climate to assess past Arctic climate variability and its sensitivity to climate forcing. These will provide the critical basis to resolve existing debates on the stability of our climate system.

Detailed Project Description
Arctic climate change has global implications because some of the most sensitive tipping points amplifying global variability (such as deep-water formation, sea ice extent, thawing permafrost) are intrinsic to the Arctic region. Nonetheless, our understanding of climate tipping points and their impact on future Arctic and global climate remains limited due to the shortness of observational records and the absence of prominent, high-impact events to serve as potential analogues for future change. It is essential therefore to develop and apply indirect measures of climate to assess past Arctic climatic variability, stability, and sensitivity to climate forcing. To date, the majority of climate proxies are unable to quantify sea surface temperatures or the carbonate system in Arctic/Subarctic Oceans because biological and physiochemical processes besides temperature influence their geochemical composition in cold seawater. SiTrAc addresses this critical gap by pioneering a new holistic multidisciplinary approach to palaeoceanographic proxy development that considers foraminifera as a living organism and not just as a proxy carrier. Using innovative biogeochemical techniques and micro-structural analyses of polar foraminifera *Neogloboquadrina pachyderma* (NP), which is the dominant and often only species present in surface waters below 4C, SiTrAc will track essential climate variables via the living proxy into the archive (i.e., marine sediments). Further, SiTrAc's unique research strategy will quantify the biological and physiochemical

processes influencing how geochemical tracers are recorded at the time of proxy development, thereby advancing our understanding both of proxies and Arctic climate. SiTrAc forms the critical basis for testing new hypotheses for the drivers and tipping points of Arctic and global change past, present, and future.

PhD 1: The impact of physiological and ontogenetic processes on geochemical tracers recorded in planktonic foraminifera

The leading hypotheses describing the incorporation of Mg, B, O, and C species into calcium carbonate proposes that alongside seawater pH/carbonate ion and temperature, calcification and metabolic rates exert a control on the geochemical composition and isotopic fractionation in planktonic foraminifera (PF). Also, it is often assumed that PF migrate vertically in the water column during their life cycle. However, whether this is the case and how/if migration influences the geochemical tracer recorded in pristine calcite, and how it is subsequently represented in climate archives remains unknown. To address these gaps in knowledge it is therefore essential to determine the impact of both physiological and ontogenetic processes on geochemical tracers recorded in live PF.

To achieve these goals, the successful candidate will constrain PF respiration/metabolic rates on living specimen collected via plankton tows from Greenland, Irminger, and Labrador Seas to empirically constrain the hypothesised relationship between porosity and respiration for PF. Further, the candidate will determine calcification and growth rates of the same individuals using 3D volume reconstructions of test chambers using novel advances in microCT imaging to identify individual chamber thickness and volume during growth. The successful candidate will also constrain the hydrographic parameters of the calcification environment to identify the empirical relationships between geochemical tracers, essential climate variables, respiration, calcification, and growth rates. To assess vertical migration, live PF specimen will be collected and analysed from closely spaced tows (e.g., 20 m depth intervals). These will elucidate whether geochemical signals can be traced to distinct depth intervals and thereby constrain migration. This PhD position will be Co-supervised by Dr Audrey Morley (University of Galway) and Dr Julie Meilland (MARUM, Bremen University).

PhD 2: The impact of early diagenetic processes in surface marine sediments on geochemical tracers recorded in planktonic foraminifera

Early diagenetic processes begin the moment PF touch the sediment. The physical evidence left behind by early diagenesis in the top-most sediments is expected to be less and not on the same scales as observed by net dissolution and overgrowth precipitation typically associated with deep-time diagenesis. Still, recent evidence suggests that early diagenesis may alter the SST signal of the Mg/Ca – temperature proxy by 2-3 °C. However, the impact of early dissolution, linked to organic matter degradation and stable mineral recrystallization (e.g., mineral-fluid exchange) in surface sediments specifically on high Mg phases in PF calcite are rarely considered or quantified.

To assess early diagenesis of PF at the sea floor, the analysis of pore water geochemistry will be paired with trace element, isotope, and microstructural analysis (microCT) on recently deposited NP from a large collection of multicores retrieved from different depositional environments (e.g., open ocean, slope, shelf). Specifically, the successful candidate will target the potential of short-term mineral-fluid exchanges within the top 30 cm of sediment, which exhibits sharp gradients in oxygen, microbial activity, pH, alkalinity, and biological activity for a diverse set of depositional environments. The impact of recrystallisation on geochemical tracers will be assessed via paired SEM-EDS elemental mapping and solution analysis of Mg, Sr, Mn, and $\delta^{13}C$. To test if early diagenetic processes are indeed a feature of distinct depositional environments and porewater chemistries, the successful candidate will also assess the presence of microstructural and geochemical diagenesis markers in the epibenthic foraminifera *Cibicidoides wuellerstorfi*. This will confirm whether observed markers are truly linked to depositional environments and their respective geochemistry. This PhD position will be supervised by Dr Audrey Morley (University of Galway).

Living allowance (Stipend): €18,500 per annum, [tax-exempt scholarship award]

University fees: €5,500

Start date: March 1st 2023

Academic Entry Requirements:

Essential Criteria

- Undergraduate and/or Post-graduate thesis in Micropaleontology, Palaeoceanography, Paleoclimatology, or related fields.
- Academic Excellence
- Proficiency in written and spoken English.
- Must be highly motivated
- The ability to work independently as well as in interdisciplinary research groups.

Desirable Criteria

- Previous laboratory experience using a dissecting microscope
- Comfortable using command driven software programmes (R, Matlab, etc.)
- Should have a suitable background in Micropaleontology Paleoclimatology or Palaeoceanography, preferably involving marine calcifying organisms / microfossils.

To Apply for the Scholarship:

- CV (two pages max.)
- Cover letter (two pages max.) – Here the applicant is required to describe their interest in the programme and how their skills/competencies match their selected PhD topic
- Two referees

Please email all documents as one pdf file to audrey.morley@universityofgalway.ie

Contact Name: Dr Audrey Morley
Contact Email: audrey.morley@universityofgalway.ie

Application Deadline: 15/01/2023 and time [18:00] (Irish time 24hr format)

For information on moving to Ireland please see www.euraxess.ie